Constraining dark energy and inflation parameters with the WFIRST GRS

Graeme Addison
gaddison@jhu.edu

On behalf of Chuck Bennett (JHU), Janet Weiland (JHU) & Eiichiro Komatsu (MPA)

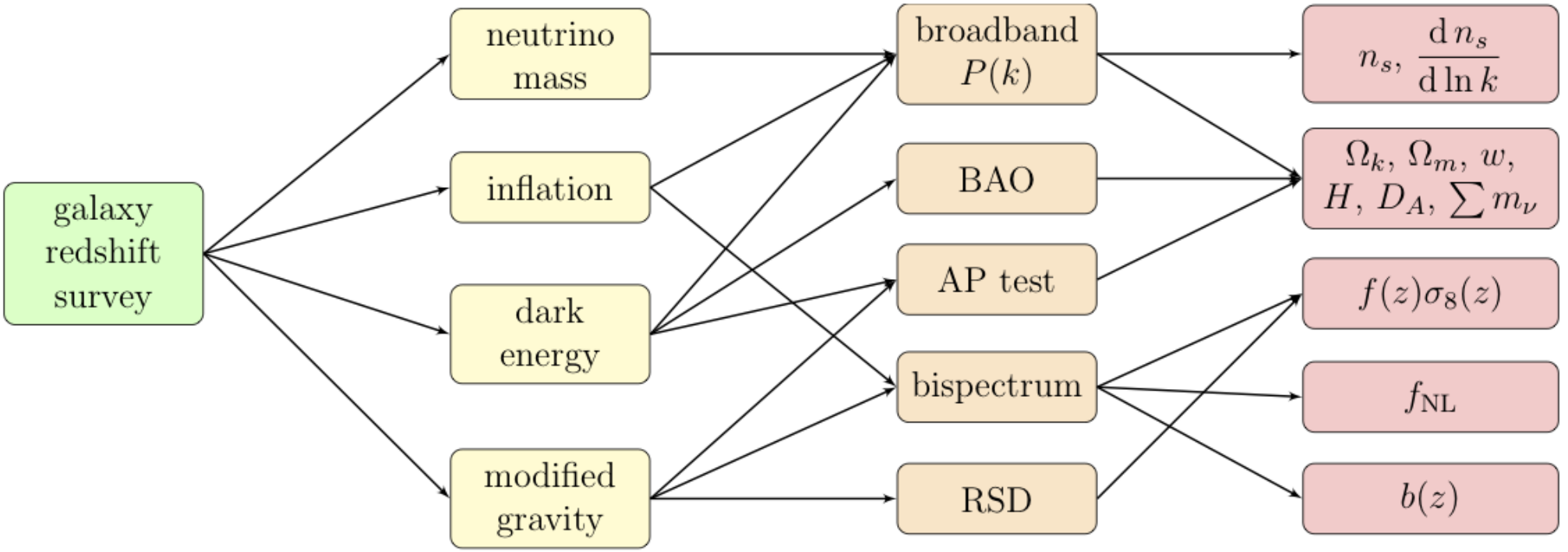
Proposal

1) What constraints does WFIRST/AFTA place on inflationary and dark energy cosmological parameters for a given instrument design and observing strategy?

2) How do these constraints change with variations in mission parameters (sky area, observing durations, sensitivity, purity, astrophysical assumptions, systematic errors, etc.)?

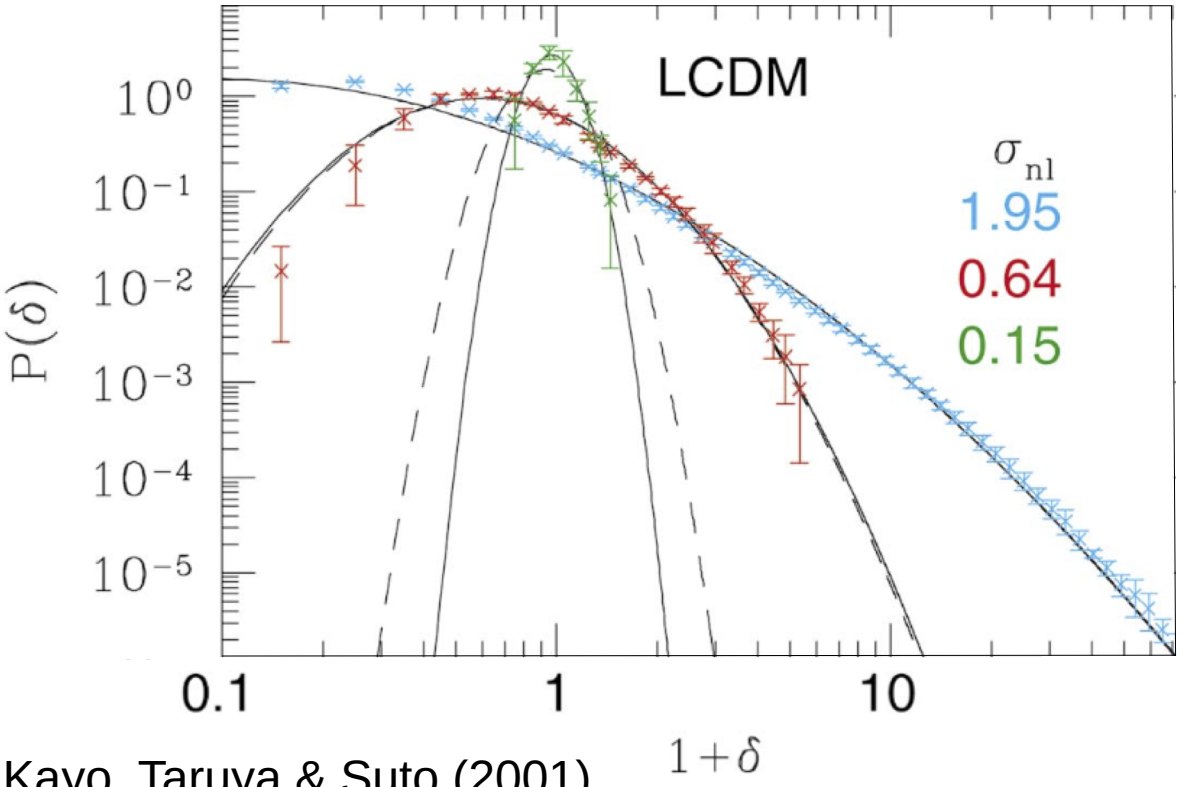
3) How should requirements or capabilities be included in the design to ensure the dark energy and inflation parameter estimates can be met?

Cosmology from galaxy redshift surveys



science signatures parameters

Lognormal realizations

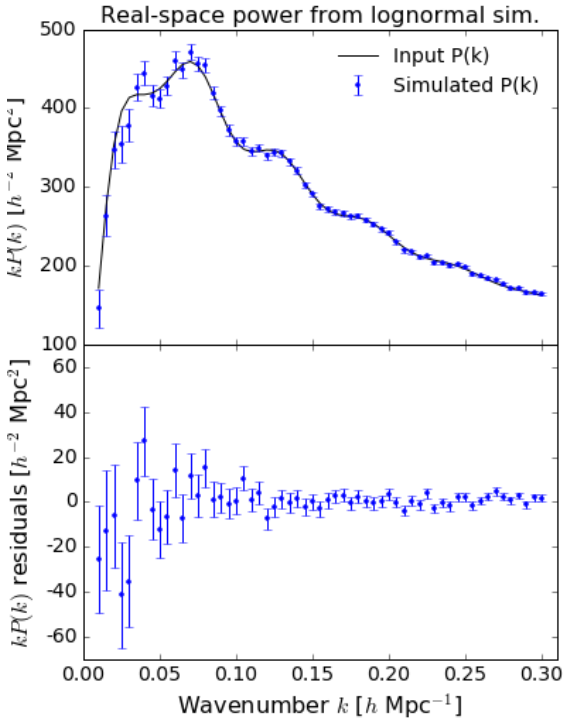


Kayo, Taruya & Suto (2001)

- Density fluctuation field
$$\delta = \frac{\rho}{\bar{\rho}} - 1$$
- Log-normal assumes that
$$\ln(1+\delta)$$
is Gaussian, instead of δ itself
- Useful approximation for computational speed and fast exploration of parameter space

- ***Input cosmology model*** *(inc. LFs, bias properties)*
- *Survey* ***geometry*** *and source density (zodi/stellar density)*
- *Catalog* ***completeness*** *and* ***purity***
- *Different* ***non-linear*** *effects*

Recovering input parameters



Multipole power spectra from catalogs of position, velocity

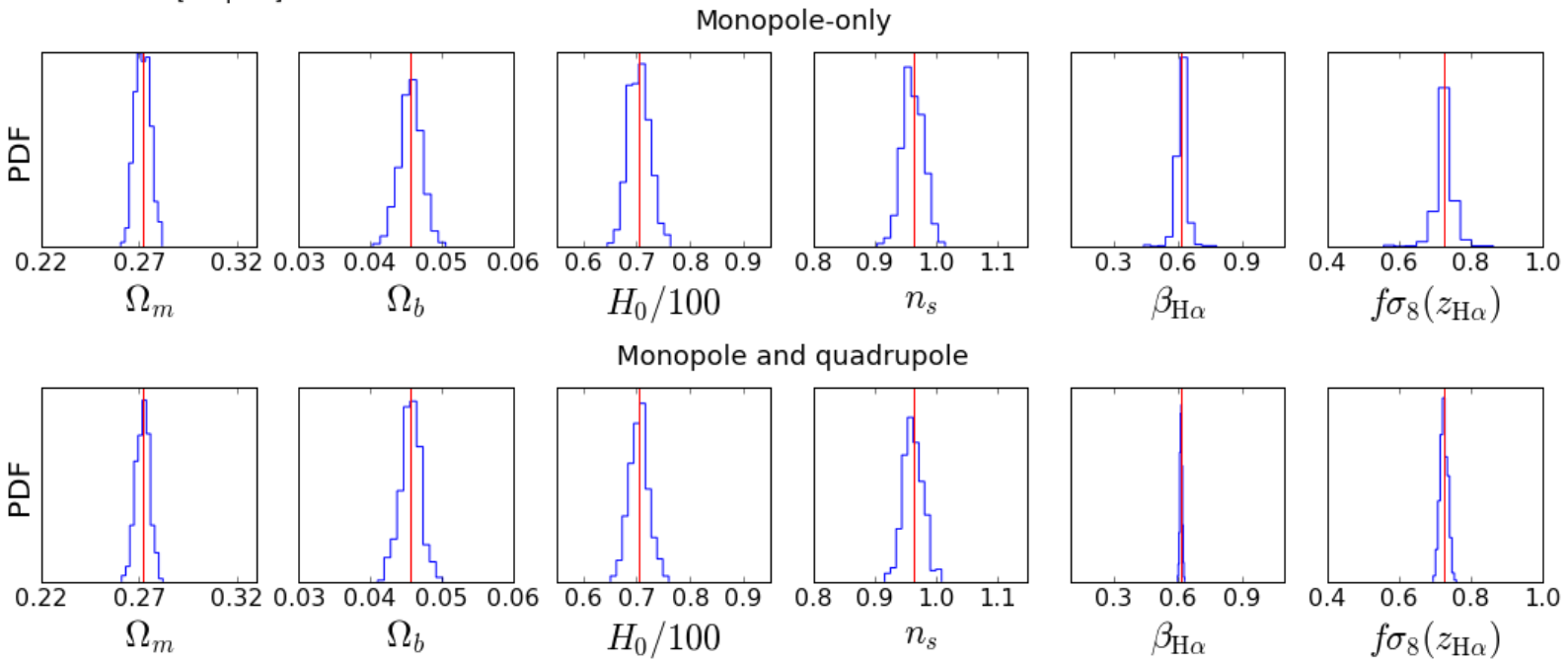
$$P_\ell(k) \equiv \frac{1}{2}\int_{-1}^{1} d\mu\, P(\mathbf{k},\mu)\,\mathcal{P}_\ell(\mu)$$

$$P_0(k) = \left(1 + \frac{2}{3}\beta + \frac{1}{5}\beta^2\right) P(k)$$

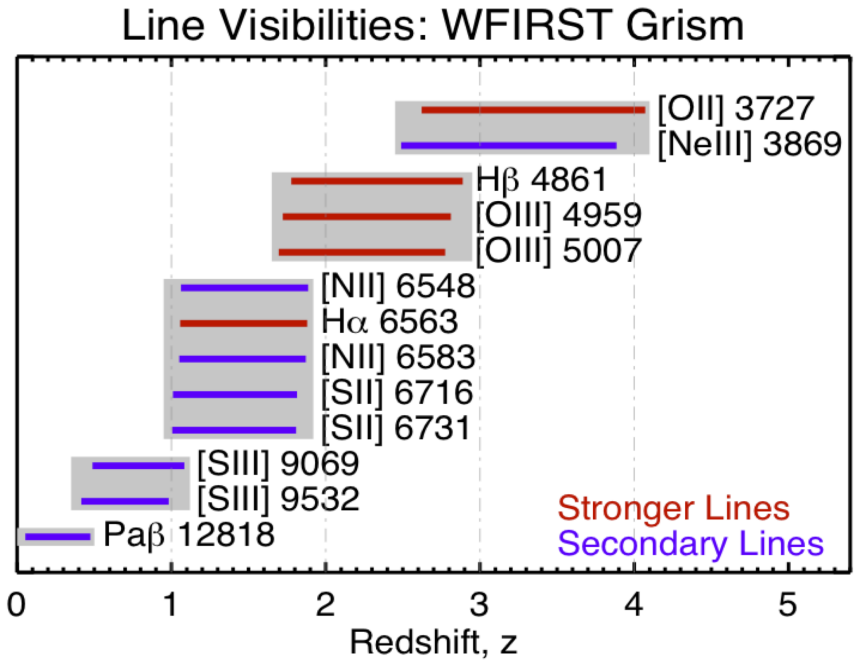
$$P_2(k) = \left(\frac{4}{3}\beta + \frac{4}{7}\beta^2\right) P(k)$$

RSD parameter

$$\beta \equiv \frac{f}{b}$$

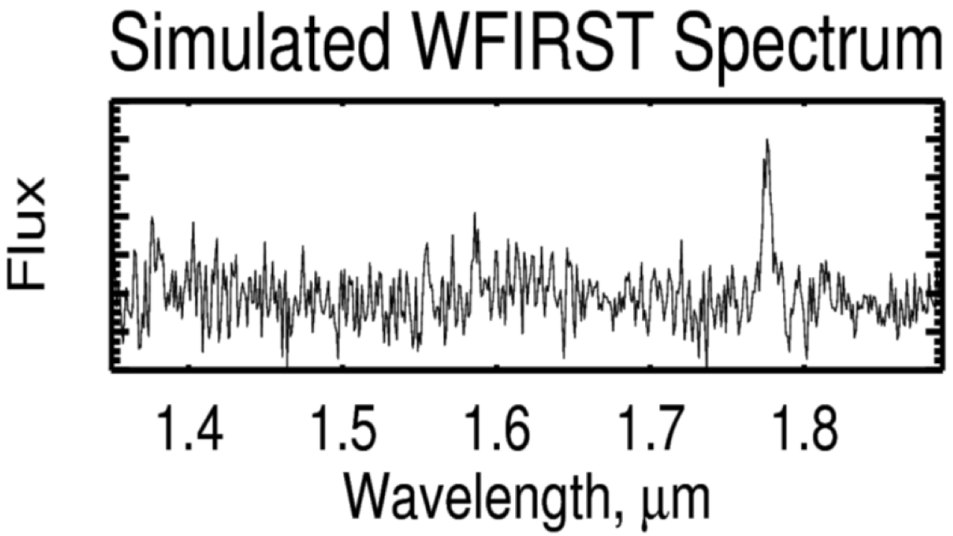


Interlopers and line mis-identification



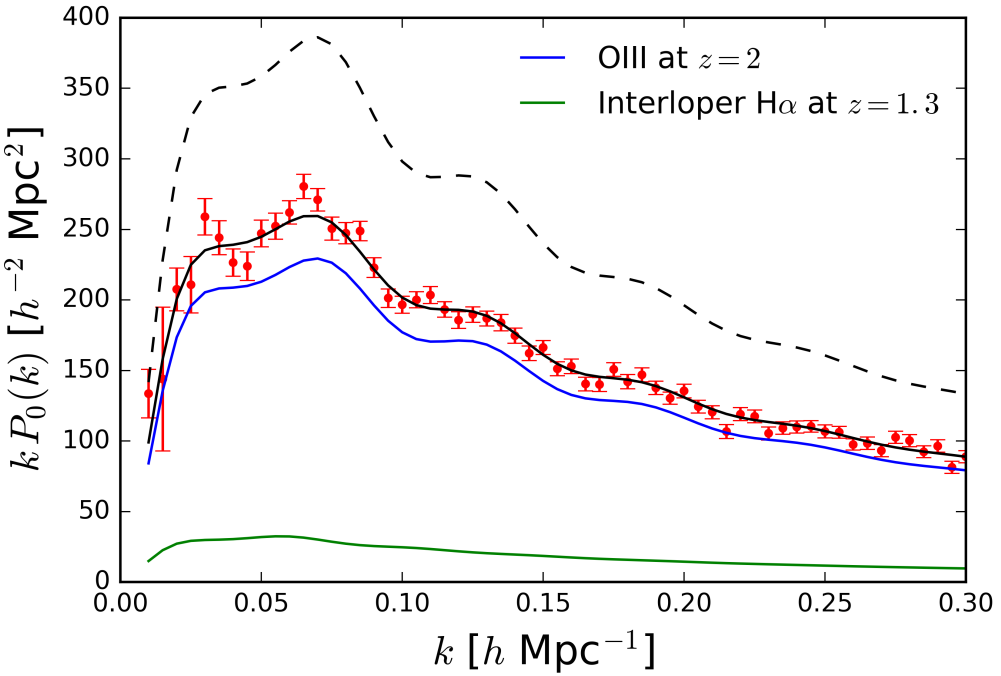
- Limited grism spectral range (1.35 – 1.89 um) → line mis-IDs occur (incorrect z) causing overlay of structure on the wrong scales.

- Mitigation strategies include secondary line recognition, EW, color cuts and use of non-spectral z-determinations (photo-z's, statistical clustering methods).



Pullen *et al.* (2015) – need interloper fractions ***<0.2%*** to avoid bias in cosmological parameters

OIII and Hα

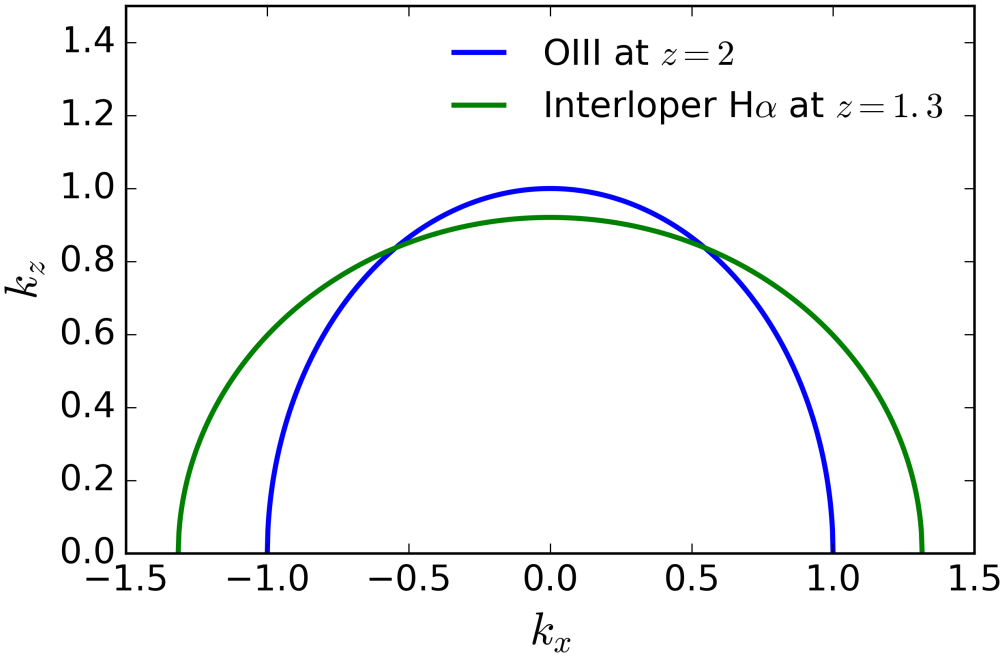


- Interlopers also trace LSS
- We are already trying to do cosmology with both Hα and OIII...
- (we already have to worry about bias etc. for these ELGs)
- Can ***model*** interloper contribution to power spectrum

$$P(k) = (1-f)^2 P_{\rm target}(k) + f^2 a^2 b P_{\rm int}(k')$$

~400k of 16M Hα ELGs mistaken for OIII and end up in catalog with 1.4M OIII ELGs; *f*~0.2

Also investigating ***anisotropic mapping*** of interlopers (c.f. RSD quadrupole effect)



Future plans

- Quantifying interloper modeling (eliminate bias in params? degrade constraints by how much?)
- Binning in redshift
- Chip modeling we have already worked on – bring in instrument uncertainties and systematics
- Modifying footprint propagating effects of zodi, stellar density into catalog (source density etc.)
- Bispectrum